

CPP WE: Retaining & Graduating Women in Undergraduate Engineering

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Dr. Kristina Rigden is the Director of Outreach Programs and the Women in Engineering Program for the College of Engineering at California State Polytechnic University, Pomona (Cal Poly Pomona). In her position, she provides several different outreach programming events to engage K-12 female students to pursue STEM majors and/or careers. Dr. Rigden holds a B.A. in Liberal Studies from Cal Poly Pomona, a TESOL certificate, a M.A. in Teaching with a multiple-subject credential and an Ed.D. from the University of Southern California.

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Ms. Nicole Gutzke is the Outreach Liaison with Cal Poly Pomona College of Engineering (CoE). As the Outreach Liaison, she is heavily involved in growing Cal Poly Pomona's PLTW Summer Core Training Institute into a seven-week event that introduces hundreds of K-12 educators to the latest in STEM-related curriculum. As the Outreach Liaison, Nicole helps to recruit, retain, and graduate hundreds of female engineers each year through outreach events. Nicole also provides support for the CPP CoE Femineers™, a program that was recognized by the White House in 2015.

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Abstract

Research shows that the number of women pursuing degrees in STEM (Science, Technology, Engineering, and Math) fields is disproportionately less than the number of women pursuing degrees in the same fields. Cal Poly Pomona's Women in Engineering (CPP WE) Program seeks to do its part in countering this disparity by engaging all men and women within the College of Engineering for the purposes of recruiting, retaining, and graduating greater numbers of female students.

Introduction

California State Polytechnic University, Pomona (Cal Poly Pomona) is part of the 23-campus California State University system in California. Cal Poly Pomona has a "learn by doing" philosophy and is ranked fourth in top public schools by U.S. News & World Report (2018). The College of Engineering has 5,800 students and is ranked first in the state of California in Hispanic engineering enrollment and degrees. One out of every 14 engineers in California is a graduate of Cal Poly Pomona [1]. The College of Engineering is nationally ranked eleventh among masters granting institutions.

Background

The purpose of this paper is to inform other engineering colleges and universities about our Women in Engineering program and the success that it has seen over the last five years. We have several events in the college for female faculty and students, and K-12 outreach events focused on recruiting females in STEM. Through the Women in Engineering program, female undergraduate enrollment has risen to 20.7% in the 2018-2019 school year from 13.8% in 2012 when CPP WE was founded.

The Cal Poly Pomona Women in Engineering (CPP WE) program was established in 2012 as a Dean's Office initiative to provide young women the resources and supportive services to succeed in engineering. CPP WE serves female undergraduate and graduate students and faculty in the College of Engineering. CPP WE focuses on recruitment and retention efforts, as well as overall environment enhancement programs. The CPP WE community is made up of women of all racial and ethnic backgrounds encompassing all seven departments in the College of Engineering at Cal Poly Pomona.

CPP WE is open to all College of Engineering students and membership is not required. All events and support services are provided free of charge. CPP WE is not a club, although we encourage partnerships with SWE and other student organizations.

Mission Statement

CPP WE is dedicated to engaging all women within the college of engineering. CPP WE strives to recruit female engineers by bringing awareness and exposure of engineering programs

to women while retaining and graduating current students by providing a welcoming environment for them. The program provides greater participation by women through K-12 outreach activities, by means of inspiring prospective and current students to be successful engineers, and by continuing engagement with alumnae in engineering industries. CPP WE promotes a close community for female engineering students through proactive retention activities and seeks to create an environment in which women can thrive in the classroom and beyond in their careers.

Program's Outcomes

1. CPP WE will engage current students through K-12 outreach activities for young women to increase awareness of and exposure to multiple engineering programs and their great impact on society.
2. CPP WE will provide a welcoming environment for prospective students to learn about the college of engineering and the women in engineering programs.
3. CPP WE will retain and graduate current female students by fostering a supportive community and enriching their experiences within the college of engineering.
4. CPP WE will create a supportive network of alumnae to provide mentoring to current female students and to increase career and internship opportunities for current female students.

CPP WE Events

In collaboration with corporations, engineering alumni, University offices, faculty, and students, CPP WE has initiated a variety of activities, including WE Chats, WE Talk Alumnae Speaker Series, and a variety of ambassador activities. These initiatives are extended to students and faculty throughout the college and the local community.

Faculty events. Each quarter, a female faculty luncheon and a STEM joint female faculty luncheon are held. The female faculty luncheon is for engineering faculty to gather, have lunch, discuss upcoming events, and discuss a topic that the CPP WE Faculty Coordinator has chosen. The STEM joint female faculty luncheon is hosted by the Colleges of Agriculture, Engineering, and Science. Each semester, a college will take a turn hosting the event. Programming focuses on the faculty tenure track process, mentorship, and recognition for research and teaching.

Student events. Several events are held for the female undergraduate and graduate students: fall welcome lunch, open house, WE chat, WE talk, graduation breakfast, and graduation recognition dinner. The annual Fall Welcome Lunch is held to welcome the incoming female engineering first-year freshman and transfer students to Cal Poly Pomona. At this lunch, students meet and interact with other female engineering students, engineering faculty, alumni, and industry representatives.

CPP WE Open House is an annual event for admitted students, held in conjunction with Engineering Scholar's Day to encourage more young women to make the decision to enroll in the College of Engineering. Students meet the College of Engineering staff and faculty, take a campus or College of Engineering laboratory tour, and attend an engineering club fair.

Each semester, a WE Chat is held. A WE Chat provides the opportunity for female faculty and students to connect and learn about each other. The program provides female students in the College of Engineering an opportunity to have lunch with female faculty from their respective departments. Faculty engage in conversation about their career path to engineering, challenges they faced, and advice to women pursuing an engineering degree. Students are invited by department/major.

During the WE Talks, alumnae are invited once a quarter to speak to current female engineering students and to offer tools to succeed in various areas of engineering including academics and professional development. Current female engineering students will have the opportunity to network with alumnae and other students. Through the WE Talk speaker series, students will have the opportunity to learn about skills that will help them succeed academically and professionally.

An informal graduation breakfast and a formal graduation recognition dinner are held in May. At the graduation breakfast, students are able to pick up their CPP WE cord and medallion to wear at commencement. Students are welcome to bring their family to the graduation recognition dinner and celebrate their accomplishment.

CPP WE Ambassadors are volunteer positions that assist with the organization and coordination of any upcoming events and activities, such as volunteering at outreach events and being trained to facilitate the CPP WE table at campus events including welcome fairs, club fairs, open houses, and STEM events. There is also a CPP WE meeting held during lunch time twice a year to reward students for their participation in the program and make them aware of upcoming activities. In addition to the CPP WE Ambassador role, the CPP WE Coordinator is a paid part-time student assistant job. The job duties include writing the quarterly newsletter, planning the ambassador meetings and assisting with CPP WE duties.

Table 1
Total Female Students Served Through CPP WE Events

Year	Number
2011-12	1,851
2012-13	1,293
2013-14	703
2014-15	522
2015-16	738
2016-17	841
2017-18	1,779
Total	7,727

Outreach events. CPP WE is dedicated to not only creating a supportive community for our current female engineering students, but also strives to inspire young girls to consider engineering as a possible career. Exposing young girls to the creativity and excitement of engineering through hands-on activities and role models is an excellent way to build confidence

in their capacity within the engineering field. We hope to inspire many young girls to reach their potential through engineering!

There are three key activities that our CPP WE outreach is focused around: Femineer[®], Introduce a girl to engineering, and E-Girl (Engineering-Girl). The Femineer[®] Program is a 30-hour three-year curriculum (Creative Robotics, Wearable Technology, and Pi Robotics) for K-12 female students to encourage their interest in engineering. Creative Robotics focuses on Scratch programming by using the Hummingbird control platform. The robot structure is open-source and includes a controller board, sensors, motors, and real wiring. Wearable Technology concentrates on C programming with an Arduino chip control platform, sewing with conductive thread, and soldering. The focus of Pi Robotics is on Raspberry Pi by using the Python programming language to build a robot and give tasks to the robot to perform. The skills that the Femineer[®] students are learning in this three-year program entail skills that engineering students are exposed to in college; however, the Femineer[®] students are able to learn the curriculum through hands-on experience and become confident in these skills before entering college.

Introduce a girl to engineering is an annual event attended by local middle school female students to encourage the exploration of careers in engineering. There are different break-out groups that the students rotate through to experience different types of hands-on engineering activities. For example, the first activity is tendon actuated robotic hand which illustrates the use of tendons for movement in robotic arms and cranes, and prosthetic hands. This activity introduces students to mechanical and biomechanical engineering by using cardstock paper and straws. The second activity is associated with electrical engineering. Students will create a simple circuit to light up an LED and put the LEDs into a 3D printed object. The third activity is creating a walking robot using a small dual shaft motor and battery. The fourth activity is creating a metal molecule with pipe cleaners and pom poms to illustrate chemical and materials engineering. The last activity demonstrates mechanical engineering by having students construct a Ferris wheel out of Popsicle sticks. These different activities show the students that there are different majors and careers in engineering.

E-Girl is an annual event attended by local high school girls. Funded by the Cal Poly Pomona Kellogg Endowment Program and with support from the College of Engineering, in fall 2013, a service learning course and an evening parent-child event (E-Girl) were envisioned by two Cal Poly Pomona engineering undergraduate underrepresented students and Dr. Mónica Palomo. The program has used service learning, along with outreach activities, to give engineering students the opportunity to immerse themselves in the K-12 classroom. The program consisted of a year-long experience starting with a fall term service learning course and ending with a spring term evening event where K-12 students, parents and teachers, and engineering students network while having fun with STEM workshops and activities. During the service learning course, engineering students developed skills to become mentors and teachers for middle and high school students and led the development of STEM activities.

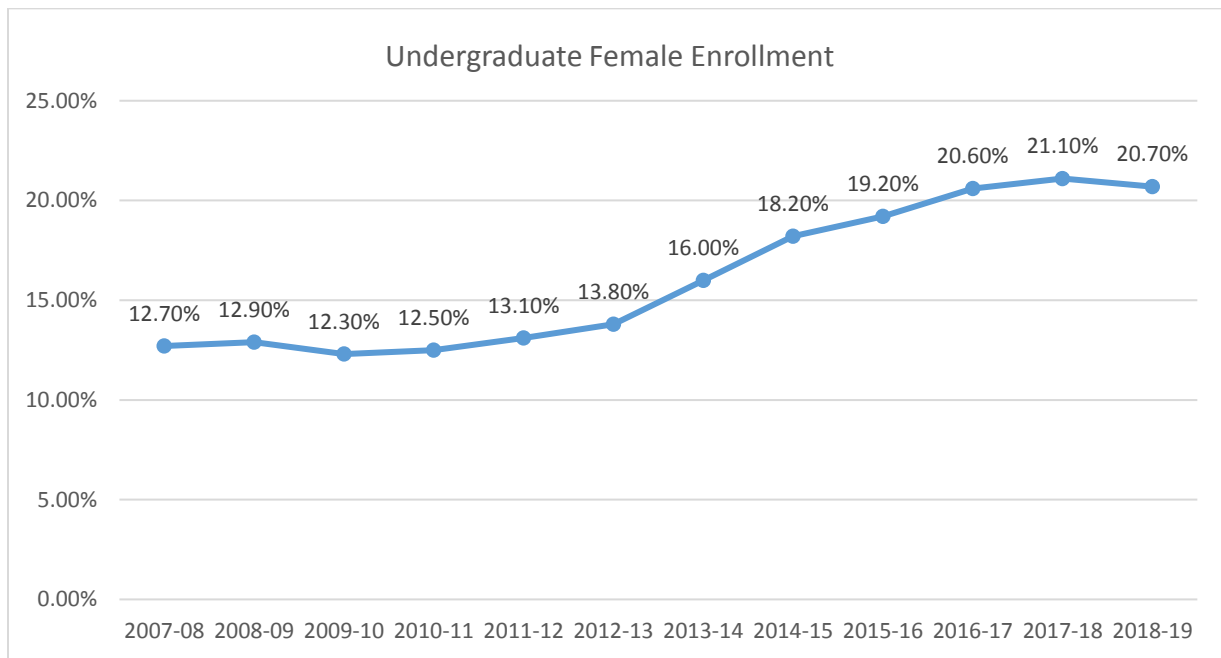
At all three of our outreach activities, parents are encouraged to attend to learn more about university life, studying engineering, and opportunities available to their daughters. For example, there are many guest speakers from Cal Poly Pomona and engineering industry that attend the outreach events. Representatives from First-Year Experience, Financial Aid, and the

Educational Opportunity Program speak at the outreach events to show students the different opportunities that are available to them at Cal Poly Pomona. Female executives from engineering industry are the keynotes speakers for the outreach events and there are also panels on young women in STEM to show the female students that it is possible to major in a STEM field and get a job after graduation. Students are also given the option to take a campus tour, an engineering laboratory tour, a BioTrek tour, a Farm Store tour, or an Arabian horse center tour. All of these options are to show the students how much is available at Cal Poly Pomona, should they choose to attend the university.

Current Data

Since the creation of CPP WE, data has been collected on the program to monitor its growth. Looking at the chart below, undergraduate female enrollment has steadily risen from 12.7% in 2007 to 13.8% in 2012 when CPP WE was founded, and 20.7% in the 2018-2019 academic school year.

Figure 1. College of Engineering Undergraduate Female Enrollment



Sustainability of the Program

Founded in 2012 as a Dean’s office initiative, funding was initially supported by a Kellogg Legacy Grant. The Northrup Grumman Foundation has pledged additional support and an endowment was set up by Edison International.

Impact of the Program

Throughout the multiple CPP WE events, students have deemed the CPP WE Program an integral part of their college experience. The support system that has been created through the

CPP WE Ambassador Program has enabled students to take on leadership opportunities within the outreach events and network with sponsors and industry leaders. CPP WE Student Ambassador Shannen Sharma has said “the CPP WE program has provided me with a strong and supported community throughout my whole college career. This has always been very important for me being a female in the engineering program. I have been a part of this program since my first year of college and it has been such a rewarding experience that has helped me grow as an individual.”

In addition, the percentage of undergraduate female students earning bachelors degrees in engineering has risen since the CPP WE Program was established.

Table 2. Percentage of Undergraduate Female Degrees Awarded in Engineering

Year	Female Degrees Awarded %
2009-10	11.4%
2010-11	13.0%
2011-12	13.5%
2012-13	13.8%
2013-14	10.4%
2014-15	15.2%
2015-16	15.9%
2016-17	15.8%
2017-18	20.4%

Future Research

Additional research is needed on the CPP WE program to determine which initiatives are the most effective for the female engineering students. For example, are the WE Talks and WE Chats important for the students? Did the CPP WE Open House make a difference in admitted students deciding to enroll at Cal Poly Pomona? Is the role of a CPP WE Ambassador participating in the Outreach Events a significant indicator of female student retention in engineering? Also, do female students who participate in CPP WE show a stronger retention rate versus females who do not participate in CPP WE?

Conclusion

CPP WE lives by its mission statement and is embodied in the outcomes of the program. While CPP WE strives to make a difference in the lives of young women, it is our hope that more females will want to pursue engineering in their future college and career.

References

- [1] U.S. News & World Report (2018). California State Polytechnic University – Pomona.
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